The Relationship Between Visible Ozone Injury and Ambient Ozone Exposures

Forest Health Monitoring Ozone Biomonitoring Network

1996—1999 Northern Region

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Introduction

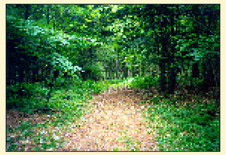
- The Forest Health Monitoring (FHM) ozone bioindicator data has enormous value as the only large-scale biological network of ozone air quality.
- The ozone bioindicator network uses the visible foliar injury response of plant leaves to detect and monitor the presence or absence and intensity of ozone stress in forest ecosystems.

Goals

- The objective of our analysis is to show a relationship between ambient ozone exposures and visible plant ozone injury on bioindicators.
- This data will provide evidence of ozone stress that could be used in the next scientific review of the USEPA secondary ozone standard to protect plants.

Methods

- During the ozone injury evaluation window in August, trained field crews surveyed **1,184** biomonitoring sites by rating ten to thirty individuals of at least one ozone sensitive plant species for foliar injury. All sites must meet minimum site quality criteria to be acceptable, e.g., good fertility and water holding capacity and away from confounding influences such as powerlines and excessive disturbance. Voucher samples from ozone injured species at each site must be submitted to the national indicator lead for verification.
- The ozone exposure maps are spatially interpolated based on ambient SUM06 values from USEPA monitoring stations. The FHM folia injury data was combined with the air data to generate the relationships.



Legend

FHM Ozone Sites
Plot level Index
- 0
- <1
- 1-2.5
- 2.5-5
- 5-7.5
- >7.5

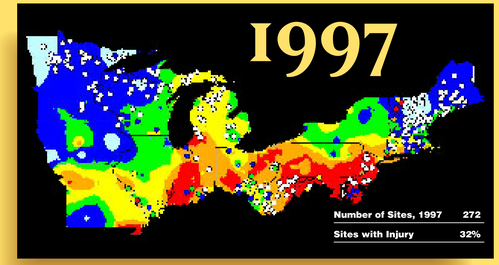
Ozone Exposures
Sum06 June-Aug,
8 a.m.–8 p.m.
Units are ppm–hrs
- 0-10
- 10-15
- 15-20
- 20-25
- 25-30
- >30

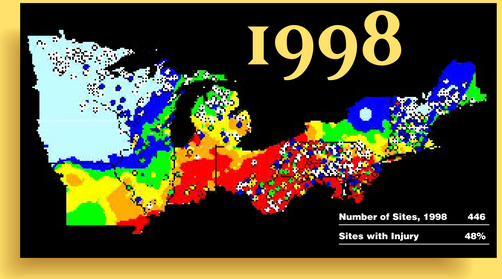
Bioindicator Species

Blackberry	Sassafras
Black cherry	Sweetgum
Milkweed	Pin cherry
Yellow poplar	Spreading dogbane
White Ash	Big leaf aster

What is the FHM Site Level Ozone Injury Index?

The sum of all injured species evaluated at the site, accounting for amount, severity and ratio of injured plants.





What is a SUM06?

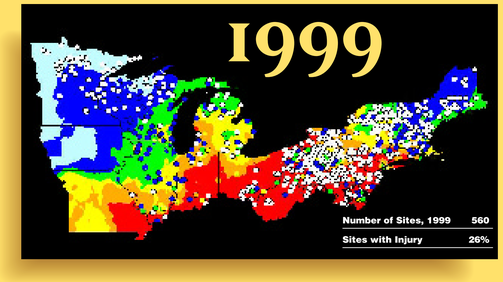
The sum of all valid hourly ozone concentrations equaling or exceeding 0.06 ppm .We used June-August, 8am-8pm, as a representative growing season in the north. SUM06 is a common index used to measure plant response.

Why is injury found in low ozone exposure areas while no injury is recorded in high ozone exposure areas?

These maps show the presence or absence of injury and the severity of injury (FHM site injury index). It is acceptable to not find injury in high ozone areas and find injury in low ozone areas.

What factors may influence plant response by year?

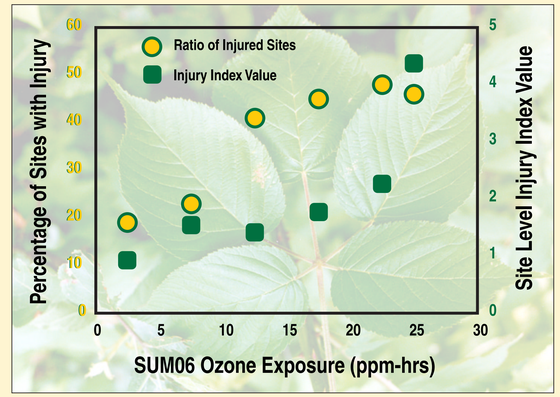
Genotypes, physiological factors, i.e. drought, and site conditions may obscure the data.



Key Findings

- Ozone exposures and visible ozone injury varies from year to year.
- Number of biosites evaluated for visible injury increased drastically every year.
- Ozone injury was found in low ozone areas (SUM06 < 5 ppm-hrs) 19% of the time.
- Ozone injury was found in high ozone areas (SUM06 > 25 ppm-hrs) 46% of the time.
- The amount and severity of injury was greater in high ozone areas compared with low ozone areas.

Ozone vs. Injury: North 1996—1999



Statistically significant relationships between SUM06 and presence/absence of injured plants per site (r^2=0.82).
Statistically significant relationship between SUM06 and FHM site level injury index (r^2=0.75).

Conclusion

The FHM ozone bioindicator program has been successful in establishing a consistent, reliable network to adequately determine ozone stress on forest ecosystems. Plant response data from this study will provide the necessary biological argument to support or refute the need for a tougher ozone secondary standard to protect plant health and characterize the risk of ozone stress to our forested ecosystems.